

**What is claimed is:**

1. A  $\geq 4$  kHz repetition rate argon fluoride excimer laser system for producing an UV wavelength 193nm output, said laser system comprising:

an argon fluoride excimer laser chamber, said excimer laser chamber for producing a 193nm discharge at a pulse repetition rate  $\geq 4$  kHz, said excimer laser chamber including at least one magnesium fluoride crystal optic window for outputting said 193nm discharge as a  $\geq 4$  kHz repetition rate excimer laser 193nm output, said magnesium fluoride crystal optic window having a 255nm induced absorption less than 0.08 Abs/42mm when exposed to 5 million pulses of 193nm light at a fluence  $\geq 40\text{mj}/\text{cm}^2/\text{pulse}$  and a 42mm crystal 120nm transmission of at least 30%.

2. A laser system as claimed in claim 1 wherein said 42mm crystal 120nm transmission is at least 35% .

3. A laser system as claimed in claim 1 wherein said 42mm crystal 120nm transmission is at least 40% .

4. A laser system as claimed in claim 1 wherein said magnesium fluoride crystal optic window has a Fe contamination level less than .15ppm Fe by weight.

5. A laser system as claimed in claim 1 wherein said magnesium fluoride crystal optic window has a chrome contamination level less than .06ppm chrome by weight.

6. A laser system as claimed in claim 1 wherein said magnesium fluoride crystal optic window has a copper contamination level less than .02ppm copper by weight.

7. A laser system as claimed in claim 1 wherein said magnesium fluoride crystal optic window has a cobalt contamination level less than .02ppm cobalt by weight.

8. A laser system as claimed in claim 1 wherein said magnesium fluoride crystal optic window has an Al contamination level less than .7ppm Al by weight.
9. A laser system as claimed in claim 1 wherein said magnesium fluoride crystal optic window has a nickel contamination level less than .02ppm nickel by weight.
10. A laser system as claimed in claim 1 wherein said magnesium fluoride crystal optic window has a vanadium contamination level less than .02ppm vanadium by weight.
11. A laser system as claimed in claim 1 wherein said magnesium fluoride crystal optic window has a lead contamination level less than .02ppm lead by weight.
12. A laser system as claimed in claim 1 wherein said laser system includes a magnesium fluoride crystal optic prism, said magnesium fluoride crystal optic prism external from said excimer laser chamber wherein said  $\geq 4$  kHz repetition rate excimer laser 193nm output is transmitted through said magnesium fluoride crystal optic prism with said magnesium fluoride crystal optic prism having a 255nm induced absorption less than 0.08 Abs/42mm when exposed to 5 million pulses of 193nm light at a fluence  $\geq 40\text{mj}/\text{cm}^2/\text{pulse}$  and a 42mm crystal 120nm transmission of at least 30%.
13. A laser system as claimed in claim 1 wherein said magnesium fluoride crystal optic window has an 200 to 210 nm range absorption coefficient  $< 0.0017 \text{ cm}^{-1}$ .
14. A laser system as claimed in claim 12 wherein said magnesium fluoride crystal optic prism has an 200 to 210 nm range absorption coefficient  $< 0.0017 \text{ cm}^{-1}$ .
15. A  $\geq 4$  kHz repetition rate fluoride excimer laser system for producing an UV wavelength  $\lambda < 200\text{nm}$  output, said laser system comprising:

an excimer laser chamber, said excimer laser chamber for producing an UV wavelength  $\lambda < 200\text{nm}$  discharge at a pulse repetition rate  $\geq 4\text{ kHz}$ , said excimer laser chamber including at least one magnesium fluoride crystal optic window for outputting said  $\lambda < 200\text{nm}$  discharge as a  $\geq 4\text{ kHz}$  repetition rate excimer laser  $\lambda < 200\text{nm}$  output, said magnesium fluoride crystal optic window having a 255nm induced absorption less than 00.08 Abs/42mm when exposed to 5 million pulses of 193nm light at a fluence  $\geq 40\text{mj/cm}^2/\text{pulse}$  and a 42mm crystal 120nm transmission of at least 30% and a 200 to 210 nm range absorption coefficient  $< 0.0017\text{ cm}^{-1}$ .

16. A laser system as claimed in claim 15 wherein  $\lambda$  is centered about 193nm.
17. A laser system as claimed in claim 15 wherein said 42mm crystal 120nm transmission is at least 35%.
18. A laser system as claimed in claim 15 wherein said 42mm crystal 120nm transmission is at least 40% .
19. A laser system as claimed in claim 15 wherein said magnesium fluoride crystal optic window has a Fe contamination level less than .15ppm Fe by weight.
20. A laser system as claimed in claim 15 wherein said magnesium fluoride crystal optic window has a chrome contamination level less than .06ppm chrome by weight.
21. A laser system as claimed in claim 15 wherein said magnesium fluoride crystal optic window has a copper contamination level less than .02ppm copper by weight.
22. A laser system as claimed in claim 15 wherein said magnesium fluoride crystal optic window has a cobalt contamination level less than .02ppm cobalt by weight.

23. A laser system as claimed in claim 15 wherein said magnesium fluoride crystal optic window has an Al contamination level less than .7ppm Al by weight.
24. A laser system as claimed in claim 15 wherein said magnesium fluoride crystal optic window has a nickel contamination level less than .02ppm nickel by weight.
25. A laser system as claimed in claim 15 wherein said magnesium fluoride crystal optic window has a vanadium contamination level less than .02ppm vanadium by weight.
26. A laser system as claimed in claim 15 wherein said magnesium fluoride crystal optic window has a lead contamination level less than .02ppm lead by weight.
27. A laser system as claimed in claim 15 wherein said laser system includes a magnesium fluoride crystal optic prism, said magnesium fluoride crystal optic prism external from said excimer laser chamber wherein said  $\geq 4$  kHz repetition rate excimer laser  $\lambda < 200\text{nm}$  output is transmitted through said magnesium fluoride crystal optic prism with said magnesium fluoride crystal optic prism having a 255nm induced absorption less than 0.08 Abs/42mm when exposed to 5 million pulses of 193nm light at a fluence  $\geq 40\text{mj/cm}^2/\text{pulse}$  and a 42mm crystal 120nm transmission of at least 30% .
28. A laser system as claimed in claim 15 wherein said magnesium fluoride crystal optic window has a 203 to 207 nm range absorption coefficient  $< 0.0017 \text{ cm}^{-1}$
29. A laser system as claimed in claim 27 wherein said magnesium fluoride crystal optic prism has an 200 to 210 nm range absorption coefficient  $< 0.0017 \text{ cm}^{-1}$

30. A  $\geq 4$  kHz repetition rate fluoride excimer laser crystal optic for transmitting a  $\geq 4$  kHz repetition rate fluoride excimer UV wavelength  $\lambda < 200\text{nm}$  output, said laser crystal optic comprising a magnesium fluoride crystal with a 255nm induced absorption less than 0.08 Abs/42mm when exposed to 5 million pulses of 193nm light at a fluence  $\geq 40\text{mj/cm}^2/\text{pulse}$  and a 42mm crystal 120nm transmission of at least 30% .
31. A  $\geq 4$  kHz repetition rate fluoride excimer laser crystal optic as claimed in 30 wherein  $\lambda$  is centered about 193nm.
32. A  $\geq 4$  kHz repetition rate fluoride excimer laser crystal optic as claimed in 30 wherein said 42mm crystal 120nm transmission is at least 35%.
33. A  $\geq 4$  kHz repetition rate fluoride excimer laser crystal optic as claimed in 30 wherein said magnesium fluoride crystal has a Fe contamination level less than .15ppm Fe by weight.
34. A  $\geq 4$  kHz repetition rate fluoride excimer laser crystal optic as claimed in 30 wherein said magnesium fluoride crystal has a chrome contamination level less than .06ppm chrome by weight.
35. A  $\geq 4$  kHz repetition rate fluoride excimer laser crystal optic as claimed in 30 wherein said magnesium fluoride crystal has a copper contamination level less than .02ppm copper by weight.
36. A  $\geq 4$  kHz repetition rate fluoride excimer laser crystal optic as claimed in 30 wherein said magnesium fluoride crystal has a cobalt contamination level less than .02ppm cobalt by weight.

37.  $A \geq 4$  kHz repetition rate fluoride excimer laser crystal optic as claimed in 30 wherein said magnesium fluoride crystal has an Al contamination level less than .7ppm Al by weight.

38.  $A \geq 4$  kHz repetition rate fluoride excimer laser crystal optic as claimed in 30 wherein said magnesium fluoride crystal has a nickel contamination level less than .02ppm nickel by weight.

39.  $A \geq 4$  kHz repetition rate fluoride excimer laser crystal optic as claimed in 30 wherein said magnesium fluoride crystal has a vanadium contamination level less than .02ppm vanadium by weight.

40.  $A \geq 4$  kHz repetition rate fluoride excimer laser crystal optic as claimed in 30 wherein said magnesium fluoride crystal has a lead contamination level less than .02ppm lead by weight.

41.  $A \geq 4$  kHz repetition rate fluoride excimer laser crystal optic as claimed in 30 wherein said magnesium fluoride crystal optic has a flat planar face oriented normal to a c axis of said magnesium fluoride crystal.

42.  $A \geq 4$  kHz repetition rate fluoride excimer laser crystal optic as claimed in 30 wherein said magnesium fluoride crystal optic has a flat planar face oriented nonnormal to a c axis of said magnesium fluoride crystal.

43.  $A \geq 4$  kHz repetition rate fluoride excimer laser crystal optic as claimed in 30 wherein said magnesium fluoride crystal has a c axis grown magnesium fluoride crystallographic orientation.

44.  $A \geq 4$  kHz repetition rate fluoride excimer laser crystal optic as claimed in 30 wherein said magnesium fluoride crystal has an 200 to 210 nm range absorption coefficient  $< 0.0017 \text{ cm}^{-1}$ .

45. A  $\geq 4$  kHz repetition rate fluoride excimer laser crystal optic window for transmitting a  $\geq 4$  kHz repetition rate fluoride excimer UV wavelength  $\lambda < 200\text{nm}$  output, said laser crystal optic window comprising a magnesium fluoride crystal with a 255nm induced absorption less than 0.08 Abs/42mm when exposed to 5 million pulses of 193nm light at a fluence  $\geq 40\text{mj}/\text{cm}^2/\text{pulse}$  and a 42mm crystal 120nm transmission of at least 30% and a 200 to 210 nm range absorption coefficient  $< 0.0017\text{ cm}^{-1}$ .

46. A  $\geq 4$  kHz repetition rate argon fluoride excimer laser crystal optic for transmitting an UV wavelength 193nm argon fluoride excimer laser  $\geq 4$  kHz repetition rate output, said laser crystal optic comprising a magnesium fluoride crystal with a 255nm induced absorption less than 0.08 Abs/42mm when exposed to 5 million pulses of 193nm light at a fluence  $\geq 40\text{mj}/\text{cm}^2/\text{pulse}$  and a 42mm crystal 120nm transmission of at least 30% .

47. A  $\lambda < 200\text{nm}$  optical fluoride crystal for transmitting a UV wavelength  $\lambda < 200\text{nm}$ , said  $\lambda < 200\text{nm}$  optical fluoride crystal comprising a magnesium fluoride crystal with a 255nm induced absorption less than 0.08 Abs/42mm when exposed to 5 million pulses of 193nm light at a fluence  $\geq 40\text{mj}/\text{cm}^2/\text{pulse}$  and a 42mm crystal 120nm transmission of at least 30% and a Fe contamination level less than 0.17 ppm Fe by weight, a chrome contamination level less than 0.08 ppm chrome by weight, a copper contamination level less than 0.04 ppm copper by weight, a cobalt contamination level less than 0.04 ppm cobalt by weight, an Al contamination level less than 0.9 ppm Al by weight, a nickel contamination level less than 0.04 ppm nickel by weight, a vanadium contamination level less than 0.04 ppm vanadium by weight, and a lead contamination level less than 0.04 ppm lead by weight and a 200 to 210 nm range absorption coefficient  $< 0.0017\text{ cm}^{-1}$ .

48. A  $\lambda < 200\text{nm}$  optical fluoride crystal as claimed in claim 47, said magnesium fluoride crystal having a Fe contamination level less than 0.15 ppm Fe by weight, a

chrome contamination level less than 0.06 ppm chrome by weight, a copper contamination level less than 0.02 ppm copper by weight, a cobalt contamination level less than 0.02 ppm cobalt by weight, an Al contamination level less than 0.7 ppm Al by weight, a nickel contamination level less than 0.02 ppm nickel by weight, a vanadium contamination level less than 0.02 ppm vanadium by weight, and a lead contamination level less than 0.02 ppm lead by weight.

49. A  $\geq 4$  kHz repetition rate argon fluoride excimer laser crystal for transmitting an UV wavelength 193nm argon fluoride excimer laser  $\geq 4$  kHz repetition rate output, said laser crystal comprising a magnesium fluoride crystal with a 255nm induced absorption less than 0.08 Abs/42mm when exposed to 5 million pulses of 193nm light at a fluence  $\geq 40\text{mj}/\text{cm}^2/\text{pulse}$  and a 42mm crystal 120nm transmission of at least 30% and a Fe contamination level less than 0.17 ppm Fe by weight, a chrome contamination level less than 0.08 ppm chrome by weight, a copper contamination level less than 0.04 ppm copper by weight, a cobalt contamination level less than 0.04 ppm cobalt by weight, an Al contamination level less than 0.9 ppm Al by weight, a nickel contamination level less than 0.04 ppm nickel by weight, a vanadium contamination level less than 0.04 ppm vanadium by weight, and a lead contamination level less than 0.04 ppm lead by weight.

50. A  $\geq 4$  kHz repetition rate argon fluoride excimer laser crystal as claimed in claim 47, said magnesium fluoride crystal having a Fe contamination level less than 0.15 ppm Fe by weight, a chrome contamination level less than 0.06 ppm chrome by weight, a copper contamination level less than 0.02 ppm copper by weight, a cobalt contamination level less than 0.02 ppm cobalt by weight, an Al contamination level less than 0.7 ppm Al by weight, a nickel contamination level less than 0.02 ppm nickel by weight, a vanadium contamination level less than 0.02 ppm vanadium by weight, and a lead contamination level less than 0.02 ppm lead by weight.